A STUDY ON SOLID WASTE COMPOSITION AND WASTE GENERATION RATE AT PERUMAHAN INDERA MAHKOTA 1 & 2, KUANTAN, PAHANG

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ABSTRACT

Solid waste is one of the three major environmental problems in Malaysia. It plays a significant role in the ability of nature to sustain life within its capacity. Currently, over 23,000 ton of waste is produced each day in Malaysia. However, this amount is expected to rise to 30,000 ton by the year 2020. A study on solid waste composition and waste generation rate at perumahan Indera Mahkota 1 & 2, Kuantan, Pahang are conducted at 20 sample which where at Taman Kota Ria and Taman Medan Masyhur. Two method are use to determine the solid waste composition, to esimate the waste generation rate in the study area and to study the factor effecting waste generation rate. The method use are by data collection(segrigate and weghing) and questionnaire distribution in a month. The data recorded based on type of house which is single storey and doube storey houses consist of six type of solid waste(food waste, plastic, paper, glass, aluminum and others waste). From the results, it is observed the highest composition of solid waste on both type of house is food waste where 51.83% for Taman Kota Ria(double storey houses) and 57.57% for Taman Medan Masyhur (single storey houses). For the other rest solid waste composition is 15.73%, 10.42%, 9.03%, 6.96%, 6.03% for Taman Kota Ria and 14.29%, 13.16%, 5.8%, 5.07% and 4.11% (Taman Medan Masyhur) for plastic, paper, glass, aluminum, and others waste respectively. The generation rate of MSW recorded are 0.22kg and 0.27kg person^{-1}day^{-1} for Taman Kota Ria and Taman Medan Masyhur respectively. From the result, the most factor increasing of solid waste in study area is life style which is consist of household size, income, occupant, education of residential. Beside that, other factor is level of awareness and solid waste management also can be influence the generation rate in residential area.

ABSTRAK

Sisa pepejal adalah salah satu daripada tiga masalah utama yang berkaitan alam sekitar di Malaysia. Ia memainkan peranan penting bagi mengekalkan kualiti dalam kuantiti alam semula jadi. Pada masa ini, lebih 23,000 tan sampah dihasilkan setiap hari di Malaysia. Walau bagaimanapun , jumlah ini dijangka meningkat kepada 30,000 tan pada tahun 2020 . Satu kajian mengenai komposisi sisa pepejal dan kadar penjanaan sisa di Perumahan Indera Mahkota 1 & 2, Kuantan, Pahang iaitu dimana ia dijalankan pada 20 sampel iaitu bertempat di Taman Kota Ria(2 tingkat) dan Taman Medan Masyhur(1 tingkat). Dua kaedah digunakan untuk menentukan komposisi sisa pepejal , untuk mangenalpasti kadar penjanaan sisa di kawasan kajian dan untuk mengkaji faktor yang melaksanakan kadar penjanaan sisa. Penggunaan kaedah adalah dengan pengumpulan data (asing dan timbang) dan pengedaran borang soal selidik dalam masa satu bulan. Data yang dicatat berdasarkan jenis rumah, iaitu satu dan dua tingkat dimana bahan terbuang yang dihasilkan terdiri daripada jenis enam sisa pepejal (sisa makanan, plastik, kertas, kaca , aluminium dan lain-lain sisa). Daripada keputusan, komposisi tertinggi sisa pepejal di kedua-dua jenis rumah adalah sisa makanan di mana 51.83 % untuk perumahan di Taman Kota Ria(2 tingkat) dan 57.57 % di Taman Medan Masyhur(1 tingkat). Bagi komposisi sisapepejal yang lain adalah 15.73%, 10.42%, 9.03%, 6.96%, 6.03% untuk Taman Kota Ria dan 14.29%, 13.16%, 5.8%, 5.07%, 4.11% (Taman Medan Masyhur) untuk sisa pepejal jenis plastik, kertas, kaca, aluminium, dan jenis-jenis sampah yang lain. Kadar penjanaan sampah terbuang direkodkan adalah 0.22kg dan 0.27kg/kapita/hari bagi Taman Medan Masyhur dan Taman Kota Ria. Dari keputusan itu, antara sebab-sebab peningkatan sisa pepejal di kawasan kajian adalah gaya hidup seperti bilangan isi rumah, pandapatan, pekerjaan dan tahap pembelajaran itu sendiri. Di samping itu, kesedaran dan cara pengurusan sisa pepejal juga boleh mempengaruhi kadar penjanaan sisa pepejal di sesebuah kawasan perumahan.

TABLE OF CONTENTS

CHAPTER 3 METHODOLOGY

CHAPTER 4   RESULT AND ANALYSIS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

Solid waste is one of the three major environmental problems in Malaysia. It plays a significant role in the ability of nature to sustain life within its capacity. Currently, over 23,000 ton of waste is produced each day in Malaysia. However, this amount is expected to rise to 30,000 ton by the year 2020 (Sobian *et al.*, 2012).

Solid waste is a generic term used to describe the things we throw away. Waste in the form of solid such as garbage, rubbish, refuse and litter is known as solid waste. Solid waste can be categorized as municipal wastes, industrial wastes, and hazardous wastes. (Davis *et al.*, 2004)

Municipal solid waste also known as domestic waste generated within community from several sources. MSW originates from residential, commercial, industrial and municipal source. Municipal waste highly homogeneous and include goods, non-durable goods, packaging and containers, food waste, yard waste and others inorganic waste. For ease of visualization, MSW is often divided into two categories: garbage and rubbish (Manaf *et al.*, 2009).

The mix up of several components that form a solid waste means the composition. Different type of waste made from different type of composition. Composition can be categorized based on the component weight percentage. In order to generate idea on waste management program, it is important to identify the waste composition in study area.

Residential solid waste composition may be varies by city in a same country. Based on earlier studies, there are several factors effecting the waste composition such as urbanization and lifestyle. Residential waste composition from non-urban city and urban city are different as the lifestyle also different as stated in earlier studies Generally, the greater the economic prosperity and the higher degree of urbanization, the greater the amount of solid waste produced (Hassan *et al.*, 2001). Therefore it is important to identify the factor that effecting residential solid waste composition as it may help to identify a way to reduce the generation rate of the waste.

1.2 PROBLEM STATEMENT

In the last two decades, MSW management became a major concern and is presently one of the main public subjects under discussion. This is probably due to the considerable increase of MSW production in both absolute and per capita values. The amount of MSW produced increases with economic growth and the demand for efficient management solution (Magrinho et. al., 2006). With this population growth, the municipal solid waste generation also increases. In 2003, the average amount of MSW generated in Malaysia was 0.5–0.8 kg/ person/day; it has increased to 1.7 kg/person, day in major cities (Kathirvale *et al.*, 2003). However, this amount is expected to rise to 30,000 ton by the year 2020 (Sobian *et al.*, 2012).

Generation rate of solid wastes will affect not only human but also environment. Solid wastes especially residential solid wastes will cause discomfort and may cause health problems. For example, decomposing of food wastes may emit strong odor that surely will cause discomfort to people and will attract flies. Flies will cause health problems to people.

In Malaysia, most of the municipal solid waste goes to the landfill or dumping sites. The non-hazardous and general industrial waste are often treated together. The existing dumping sites mostly are not properly engineered and managed. Pollutants that are released or discharged from the disposal sites could indirectly impact human life (Mahmood, 2000).

The federal government had spent RM 20.9 million to build 9 sanitary landfills and upgrade 27 existing landfills in 34 designed areas. These measured are, however, insufficient to overcome the problem of waste disposal as the waste disposal as the waste generation rate is increasing rapidly due to high population growth and urbanization. Hence, the federal and state governments are now considering to builds incinerator plants in major cities and towns. Incineration has the potential to solve the problem of landfill as the original volume and weight of wastes may be reduces up to 95% to 75% respectively. This will help to prolong the life span of landfill sites up to 10 to 20 times (Lau, 2004). However, incinerator will involve a big amount of capital investment hence become a constraint to government.

This research is necessary to estimate the real capacity of solid waste in residential area. From the result, the alternatives to minimize the value will be easy. It will also help to reduce the environmental pollution, thus avoiding deforestation.

1.3 RESEARCH OBJECTIVE

The study is mainly focus on fieldwork and questionnaire distribution. The propose of the study is to achive below objectives:

i.   To determine the solid waste composition
ii. To estimate the waste generation rate in the study area
iii. To study the factor effecting waste generation rate through questionnaire distribution

1.4 SCOPE OF STUDY

The study is conducted in Taman Medan Masyhur and Taman Kota Ria at Indera Mahkota 1 and 2, Kuantan, Pahang. A sample from 100 houses of single storey terrace houses and 10 houses double storey terrace houses are selected randomly. Twenty sets of questionnaire also distributed to the selected houses. The purpose for distributing the questionnaire is to analyze the level of awareness among resident on the solid waste generation rate. It is also aim to analyze the lifestyle of Taman Medan Masyhur and Taman Kota Ria's resident in order to find out the factors that affecting

the to generation rate. The solid waste is segregated and weighed using weighing scale. Six classes of waste are segregated by hand sorting. The six components are food waste, glass, aluminum, plastic, paper, and others. The data will be recorded to determine daily, weekly and a month waste generated.

1.5 SIGNIFICANT OF STUDY

From this study, it will help to identify the composition of the residential solid waste. By identifying the composition of the residential solid waste, the factor that effecting the residential solid waste composition can be determined. It will help to analyze the generation rate of residential solid waste of the study area. Therefore, better solid waste management system can be determined and it also will help to preserve the environment for future generation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a literature review for the current research on the composition of residential solid waste at Taman kota Ria and Taman Medan Masyhur, Indera Mahkota, Kuantan, Pahang. It is divided into three sections in which the first section discusses about sources of municipal solid wastes and types of municipal solid wastes. Second section provided types of organic waste and types of inorganic waste. Then, last section is about factor affect generation rates of residential solid waste and previous study of waste generation rate.

2.2 MUNICIPAL SOLID WASTE

Davis et al., 2004 define municipal solid waste as durable goods, nondurable goods, container packaging, food waste, yard trimming and others organic waste. The waste is from residential, commercial, and industrial non-process sources. The term municipal solid waste is generally used to describe most of the nonhazardous solid waste from city, town or village. MSW comprises two types of material which are refuse and trash. Refuse includes garbage and rubbish.

Municipal Solid Waste will increase resulting from human endeavor and will always exist in this world. It comprises of material originating from households, commercial and medical establishments, construction and demolition activities, street cleaning, and park maintenance.

Municipal solid waste are accepted less harmful than the other kind of waste in terms of environmental and public health depending on the process of their occurance. The waste determined as municipal waste involve functioned form of products such as organic substance is being changing in accordance with the cultral struture and life standards of societies. In the world, there are various approches for controlling municipal solid waste. Yet the method used for the solution of the problem have been insufficient in their own. The greatest problem is primarily the increasing amount of these wastest with each passing days. The focus of the studies performed recently on this issue is to immobilize the amount of waste or at least slow down the rate of increase. However, it is clear that the situation will conflict with the economic policies supporting the consumption growth and needs long-termed studies (Ozturk et al., 2012).

In developing solid waste composition and generation programs, it is important to identify the sources, characteristics, and quantities of solid waste. This way is to determine the type of collection service, the types of collection vehicles to be used, the type of processing facilities, and the disposal method to be used. Construction and demolition debris and special wastes that must be collected and processed separately are also will be considered in the programs.

2.2.1 Sources of Municipal Solid Waste

Municipal solid waste is solid wastes that come from domestic waste, commercial waste, community waste, construction waste and institutional waste. Mainly, municipal wastes come from domestic waste or also known as residential waste. Mohamed Osman Saeed et al., 2007 reported that residential areas produce up to 48% of solid wastes, besides commercial(24%), community(18%), construction(4%), and institutional(6%).

Tchobanoglous et al., 1993 said, the sources of solid wastes in a community are related to research location or environment. Although any number of source classifications can be developed, the following categories have been found useful such as residential, commercial, institutional, construction and demolition, municipal services, treatment plant sites, industrial, and, agricultural. Typical waste generation

facilities, activities, or locations associated with each these sources are reported in Table 2.1. As noted in table, municipal solid waste is normally assumed to include all community wastes with the system of wastes generation from municipal services, water and wastewater treatment plants, industrial processes, and agricultural operations. It is important to be aware that the definitions of solid waste terms and the classifications of solid waste vary greatly in the literature and in the profession. Table 2.1 shows the sources and type of solid waste respectively.

Table 2.1: Sources and type of waste

Source	Type waste generators	Types of solid waste
Residential	single and multifamily dwellings	food waste, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special waste (e.q., bulky items, consumer ·electronics, white goods, batteries, oil, tires), and household hazardous wastes.
Industrial	Light and heavy manufacturing, fabrication, construction sites, power, and chemical plants.	Houskeeping wastes, packaging food waste, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardbord, plastics, wood, food, wastes, glass, metals, special wastes, hazardous wastes.
Institution	Schools, hospitals, prisons,	Paper, cardbord, plastics, wood, food wastes, glass, metals, special wastes, hazardous
Construction	Government centes. New construction sites, road repair, renovition sites, demolition of buildings.	wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landcape and tree trimmings; general wastes from parks, beaches, and other recreational areas;
Process (manufacturing)	Heavy and light manufacturing, refineries, chemical plants,power	Industrial process wastes, scrap materials, off-specification products, slay, tailings
Agricultural	Crops, orchards, vineards, dairies, feedlots, frams	Spoiled food wastes, agricultural wastes, glass, metals, special wastes, wastes, hazardous wastes (pasticedes).

Source: Tchobanoglous et al., (1993)

2.2.2 Types of Municipal Solid Waste

In fourth edition of environmental engineering books mention, such solid wastes are often called municipal solid waste and consist of all the solid and semisolid materials discarded by a community. The fraction of the MSW produced in domestic households is called refuse. Until fairly recently, refuse mostly food wastes, but new materials such as plastic and aluminium cans have been added to refuse, and the use of kitchen garbage grinders has decrease the food waste component. Most of the 2000 new products created each year by oher country industry eventually find their way into municipal solid waste and contributed into individual disposal problems. This means, more solution can be practice to minimize the amount of solid waste depend on type of waste.

Types of municipal solid wastes vary based on their sources. The residential area produce food wastes, rubbish, ashes and special waste. Commercial area produce food wastes, rubbish, ashes, demolition and construction wastes, special wastes and occasionally hazardous wastes. Malaysia municipal solid wastes consist forty percent of organic waste, fourteen percent of paper, fifteen percent of plastic and others (Agumuthu et al., 2001).

Davis and Cornwell (2008) both have similarities state about the garbage originates primarily in residential or commercial area. The term garbage is defined as the animal and vegetable waste resulting from the handling, preparation, cooking, and serving of food. It is one of the types of household waste. The term does not include food processing wastes from canneries, slaughterhouse, packing plants, and similar facilities or quantities of condemned food products.

While, *rubbish* consists a variety of both combustible and noncombustible solid waste from homes, stores, and institutions, but does not including garbage. Trash is synonymous with rubbish in some parts of the country, but trash is technically a sub-component of rubbish. Combustible rubbish actually the "trash" component of rubbish which consists of paper, rags, cartons, boxes, wood, furniture, tree branches, yard, and

so on. Some cities have separate designations for yard wastes. Combustible rubbish is not putrescible and may be stored for long periods of time.

Noncombustible rubbish is material that cannot be burned at ordinary incinerator temperatures. It is the organic portion of refuse, such as tin cans, heavy metals, glass, ashes, and other else. Classification of solid waste is based on the state kind materials in this report. According to Mokhtar et al., (2013) from UMP research stated the standard type of waste is such as below:

2.2.2.1 The plastic

Plastic waste is one of the components in municipal solid waste management. Plastic are predominantly employed in packaging, construction and consumer products. The first commercial plastic were developed over one hundreds years ago. Now plastics have not only replaced by wood, leather, paper, metal, glass and natural fiber products in many applications, but also have facilities the development of entiry new types of products. Figure 2.1 present the example of plastic waste.
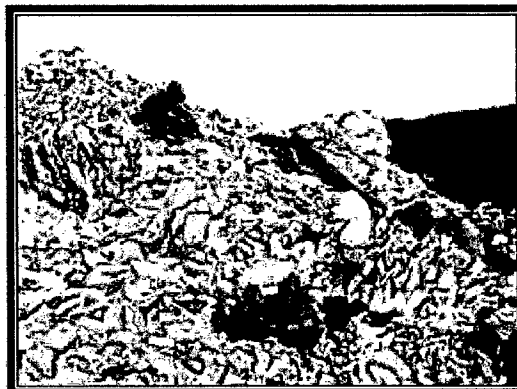

Figure 2.1: The plastic

2.2.2.2 The paper

Paper is made from cellulose fibre, the source of which can be pulped wood, or a variety of other materials such as rags, cotton, grasses, sugar cane, straw, waste

paper, or even elephant dung. There are different sources of waste fibre used as a source material for manufacturing recycled paper. Most paper waste is recycled. The main types of paper in everyday use which can be recycled are office white paper, newspapers, magazines, telephone directories and pamphlets, cardboard, mixed or colored paper, computer print out paper.

There are also different grades of paper and board collected mainly from agricultural and industrial sources. Paper materials that cannot be recycled are limited for examples, paper food wrapping as well as raw garbage, papers soiled during cleaning, cotton waste, paper cups, paper plates, paper milk cartons, carbon paper, heat sensitive paper, and paper with vinyl-coating. Figure 2.2 shows the news paper as the one of the paper solid waste.
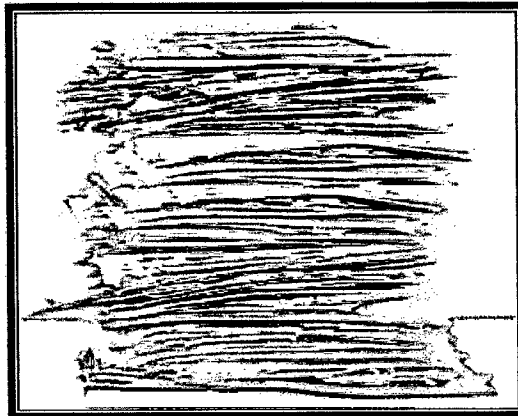
Figure 2.2: The paper

2.2.2.3 The food waste

Food losses refer to the decrease in edible food mass throught the part of the supply chain that specially leads to edible food for human consumption. Food losses take place at production, post-harvest and processing stage in the food supply chain. Food losses occuring at the end of the of the food chain when retail and final consumption or are rather called "food waste" , which relates to retailers' and consumers behavior (Petracci et al., 2010).

Petracci also said food waste is measured only for products that are directed human consumption, excluding feed and parts of products which are not edible. Per definition of food waste are the masses of food lost or wasted in the part of food chain leading to edible products going to human consumption. Therefore the food that was originally meant to human consumption but which fortuity gets out the human food chain is considered as food loss or waste even if it is then directed to non-food uses. This approach distinguishes "planned" non-food uses to "unplanned" non-food uses, which are hereby accounted under losses. Type of food waste is vegetable and animal commodities. Figure 2.3 present the vagetable as the example of food waste.

Figure 2.3: The food waste

2.2.2.4 The aluminium

Metals low density and for its ability to resist corrosion due to the phenomenon of passivation is remarkable as aluminium. Structural components made from aluminium and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials. The most useful compounds of aluminium, at least on a weight basis, are the oxides and sulfates.

Aluminum cans are lightweight, convenient, portable, and keep beverages cold. They are often used to package soda, and other beverages, and account for nearly all of the beverage packaging market for some products. In 2006, about 7.34 million tones of solid waste generated in Malaysia, enough to fill up 42 building. Previous

research also shows the metals waste composition of selected location in peninsular Malaysia where is at Kuala Lumpur, Shah Alam, and Petaling Jaya with the amount is 5.1, 6.9, and 3.9 million tones, respectively (Siraj, 2006). The example of alum waste is show in Figure 2.4.

Figure 2.4: The aluminum

2.2.2.5 The glass

Glass makes up a large component of household and industrial waste due to its weight and density. The glass component in municipal solid waste is usually made up of bottle, broken glassware, lights bulbs and other items. Adding to this waste is the fact that many manual methods of creating glass objects have a defect rate of around forty percent. Glass recycling uses less energy than manufacturing glass from sand, lime and soda. Figure 2.5 shows one of the glass waste. Approximately 13 million tons of glass waste is generated annually. According to Environment Protection Agency said food and beverage containers make up over 90% of this amount; the remaining 10% comes from products like cookware and glassware, home furnishings, and plate glass.

For centuries, glass has served as a universal packaging container, holding precious commodities like sauces and olive oil. Today, manufacturers use glass to hold everything from soda to perfume. The glass in many items, from your soda bottle to your computer, can be recycled over and over while retaining its strength. In Siraj

(2006) researched also stated the glass waste composition of selected location in Kuala Lumpur, Shah Alam, and Petaling Jaya with the amount is 3.9, 4.3, and 3.1 million tones, respectively. Food and soft drink represent the largest source of glass generated and recycled. Glass in durable goods, such as furniture, appliances, and especially consumer electronics, round out the sources of postconsumer glass.

Environment Protection Agency mentioned, glass collected at the curbside is usually commingled, meaning that different colors and types of glass are collected together. This glass might then be sorted by color, or other characteristics, at a materials recovery facility. Some municipal and commercial recycling programs require participants to separate clear, brown, and green glass. Although all glass is made of silica and soda, the type and quantity vary slightly with different types of glass. Different melting points and chemical incompatibility make it important to sort glass by color. Glass separated by color yield glass cullet of higher economic value. The examples of glass/bottles before separated are shown in Figure 2.5.

Figure 2.5: The glass/bottles

2.2.2.6 The others waste

Six type of waste are known as solid waste for residential sources, it is food waste, plastic, paper, alum, glass and for the rest is considered as other waste. The medical, hazardous waste such as batteries, rubber, textile are considered as other waste in this research.

Textiles in municipal solid waste are found mainly in discarded clothing, although other sources include furniture, carpets, tires, footwear, and nondurable goods such as sheets and towels. The characteristic of Malaysian municipal solid waste is different from other countries, due to it tropical climate with heavy rainfall, the Malaysian municipal solid waste contains high moisture content ranging from 52.6% to 66% (Hassan et al., 2001).

Medical waste, otherwise known as clinical waste, normally refers to waste products that cannot be considered general waste, produced from healthcare premises, such as hospitals, clinics, doctor offices, veterinary hospitals and labs (Petracci et al., 2010).

Waste batteries that are classified as hazardous waste can be collected under the streamlined collection standards for universal waste. These universal waste standards were created in an attempt to make it easier to collect the waste batteries and send them for recycling or proper treatment and disposal. The requirements specific to batteries are described below Environment Protection Agency.

Tire recycling or rubber recycling is the process of recycling vehicles tires that are no longer suitable for use on vehicles due to wear or irreparable damage such as punctures. These tires are among the largest and most problematic sources of waste, due to the large volume produced and their durability. Those same characteristics, which make waste tires such a problem, also make them one of the most re-used waste materials, as the rubber is very resilient and can be reused in other products. Approximately, one tire is discarded per person per year. Tires are also often recycled for use on new shoe and basketball courts products. However, material recovered from waste tires, known as "crumb," is generally only a cheaper material and is rarely used in high volumes (Price et al., 2006). Figure 2.6 present the type of waste which is considered as others waste in residential sources.